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10/581,247

05/31/2006

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23117 7590 10/23/2009
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EXAMINER

GREEN, TELLY D

ART UNIT

PAPER NUMBER

2822

MAIL DATE

DELIVERY MODE

10/23/2009

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

| | | | |
|------------------------------|--------------------------------------|--|--|
| Office Action Summary | Application No. 10/581,247 | Applicant(s) NAKAYAMA ET AL. | |
| | Examiner TELLY D. GREEN | Art Unit 2822 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 June 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 13-15, 19 and 20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 13-15, 19 and 20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>7/15/2009 and 9/21/2009</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to claims **13-15, 19** and **20** have been considered but are moot in view of the new ground(s) of rejection. Action on the merits is as follows:

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims **13-15, 19** and **20** are rejected under 35 U.S.C. 103(a) as being unpatentable over Shiomi et al. (Shiomi) (**EP 1,215,730 A1**) in view of Okamura et al (Okamura) (**US 2005/0145971 A1 now US 7,294,858 B2**).

In regards to claim **13**, Shiomi discloses (**Fig. 6, page 9, paragraph 82 to page 10, paragraph 92**) a substrate (**item 2**) in which a surface having a specified off-angle from a (000-1) carbon surface of a crystal of a first-conductive-type silicon carbide semiconductor whose base material is silicon carbide, which is a compound of carbon and silicon is formed; and at least one drift layer (**item 6**) which is formed on the surface of the substrate at a specified formation rate with a first- or second-conductive-type silicon carbide semiconductor, where the surface of the substrate having the specified off- angle is taken as the crystal growth surface of the substrate (**Fig. 6, page 9, paragraph 82 to page 10, paragraph 92**) a substrate (**item 2**).

In regards to claim 14, Shiomi discloses including at least one layer (**items 4, 16**) of a first- or second-conductive-type silicon carbide semiconductor formed on the drift layer (**item 6**) (**Fig. 6, page 9, paragraph 82 to page 10, paragraph 92**).

In regards to claim 15, Shiomi discloses (**Fig. 6, page 9, paragraph 82 to page 10, paragraph 92**) wherein the substrate serves as a cathode (**items 14, 2**) and the bipolar semiconductor device further includes a semiconductor layer (**items 16, 12**) which is formed on the drift layer and which is of a second-conductive-type silicon carbide to serve as an anode.

In regards to claim 19, Shiomi discloses (**Fig. 6, page 9, paragraph 82 to page 10, paragraph 92**) wherein the film that is to serve as a drift layer (**item 6**) and that is formed by epitaxial growth of silicon carbide is formed at a film growth rate having a film-thickness increasing rate per hour h of 10 pm/h or more.

However, the applicant has not established the critical nature of having a film-thickness increasing rate per hour h of 10 pm/h or more. “The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range.” In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990). To establish unexpected results over a claimed range, applicants should compare a sufficient number of tests inside and outside the claimed range to show criticality of the claimed range. In re Hill, 284 F.2d 955, 128 USPQ 197(CCPA 1960). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have various ranges. However, these limitations are product-by-process limitations.

"Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." In re Thorpe, 777 F. 2d 695, 698, 227 USPQ 964, 966 (fed Cir. 1985).

In regards to claim 20, Shiomi discloses **(Fig. 6)** including a buffer layer **(item 4)** formed between the substrate **(item 2)** and the drift layer **(item 6)**.

Shiomi does not specifically disclose wherein the off-angle is within a range of 2 to 10 degrees from the (000-1) carbon surface.

In regards to claim 13, Okamura **(paragraph 57)** discloses a [0001] surface orientation wherein the off-angle is 8 degrees (2 to 10 degrees) from the (000-1) carbon surface. Examiner notes that Okamura does not state explicitly that the angle of measurement is taken from the reference of the carbon surface. However, Examiner takes the position that because the applicant(s) has stated in paragraph 0004 of the specification that "A [0001] surface is represented by a plane of SiC crystal, includes a (0001) silicon surface 1 and a (000-1) carbon surface 2" that these two surfaces are parallel; thus, the Examiner takes the position that the Okamura's teachings of an off-angle of 8 degrees represents an off-angle of 8 degrees of/from all the parallel surfaces.

Therefore it would have been obvious to one of ordinary skill to one in the art at the time of the invention to modify the off angle of Shiomi with the off angle of Okamura for the

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purpose of suppressing macro steps applicable to growth of a material other than SiC and improving fabrication efficiency.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to TELLY D. GREEN whose telephone number is (571)270-3204. The examiner can normally be reached on Monday thru Friday 7:30 AM - 5:00 PM EST..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on 571-272-2429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Zandra V. Smith/
Supervisory Patent Examiner, Art
Unit 2822

/Telly D Green/

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Examiner, Art Unit 2822

October 13, 2009